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ABSTRACT

The invention relates to an electrical connecting device, and in particular to an electrical connecting device for electrically connecting a multi-core cable to a multi-core electrical conductor.

The invention provides an electrical connecting device (1) for electrically connecting a multi-core cable (2) to a multi-core electrical conductor. The connecting device includes a number of electrical connectors (3) each for electrically connecting one of the cores (4) of the cable (2) to a respective core of the conductor. The device further includes a number of separate rigid protective housings (5) each accommodating, and fully surrounding, a respective electrical connector (3). A frame (6, 7) is provided for rigidly connecting the housings (5) to one another.

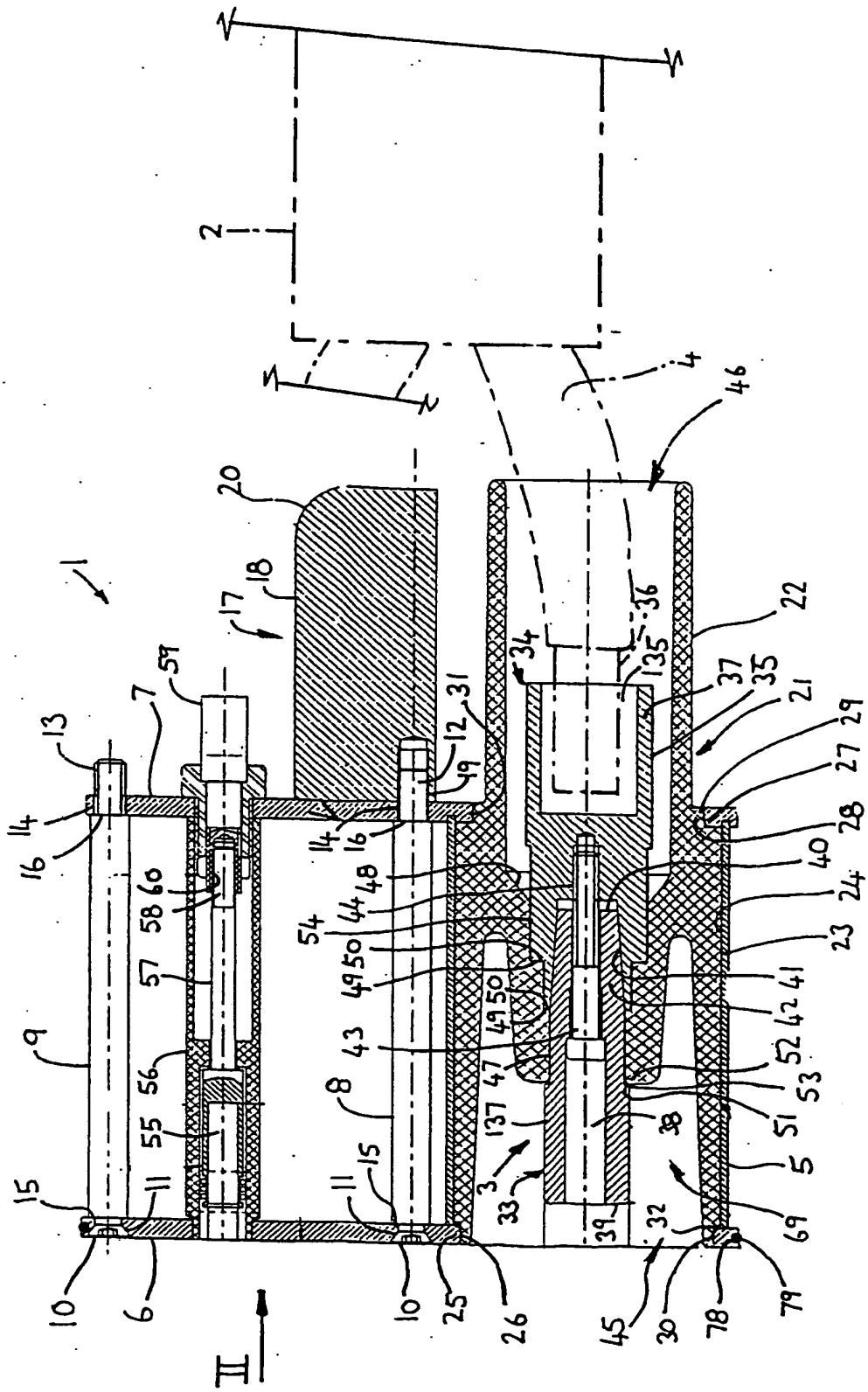
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Fig 1

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COMPLETE SPECIFICATION

FOR A STANDARD PATENT

ORIGINAL

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Details of Associated Provisional Application No. PR1242 dated 06 November, 2000

The following statement is a full description of this invention, including the best method of performing it known to us:-

File: 29575AUP01

FIELD OF INVENTION

This invention relates to an electrical connecting device and in particular to an electrical connecting device for electrically connecting a multi-core cable to a multi-core electrical conductor.

The invention has been developed primarily for use as a flameproof 11 kV 800 A coupler in the mining industry and will be described hereinafter with reference to that application. However, it will be appreciated that the invention is not limited to that particular field of use.

BACKGROUND

Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of common general knowledge in the field.

In high voltage applications, an effect known as the "Corona" effect or as "leakage" or "discharge" occurs around a conductor which is surrounded by air, where the voltage gradient in the surrounding air is sufficiently high. This effect causes a bluish appearance in the air, and results, among other things, in power loss as well as corrosion of the conductor.

Australian Patent No. 654537 and Australian Patent Application No. 58459/98 both disclose a cable couplers for multi-core cable. In both cases, the coupler includes connectors for connection to the cores of the cable, an outer casing and insulators for holding the connectors within the casing. The couplers are configured to be connected to, for example, other similar couplers, by means of interconnectors. The configuration of the couplers and interconnectors is such that there is very little open space around the connectors when the interconnectors are being used, and hence most air is eliminated thus avoiding the Corona effect. However, the structures of the couplers is such that

dismantling the couplers may be required where maintenance and replacement of parts is to be carried out. Thus, such procedures are awkward and time consuming and therefore costly.

It is an object of the present invention to overcome or ameliorate at least one of the disadvantages of the prior art or to provide a useful alternative.

SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided an electrical connecting device for electrically connecting a multi-core cable to a multi-core electrical conductor, the device including:

a plurality of electrical connectors each for electrically connecting a respective one of said cores of the cable to one of said cores of the conductor;

a plurality of separate rigid protective housings, each accommodating, and fully surrounding, a respective one of said electrical connectors; and

frame means for rigidly connecting said housings to one another.

Preferably said housings are spaced from one another.

Preferably each said housing is electrically conductive. More preferably, each said housing is of material which includes metal. Even more preferably, each said housing is of copper.

Preferably the housings are cylindrical.

Preferably each said housing is of round cross-section.

Preferably said housings are parallel to one another.

Preferably said housings are longitudinally co-extensive with one another.

Preferably said frame means includes two spaced-apart frame members disposed at respective ends of said housings, said frame members being interconnected by

interconnecting means, whereby said housings are held captive substantially between said frame members.

The device preferably includes an elongate metallic phase barrier extending from one of said frame members in a direction away from the other frame member. Said phase barrier preferably includes a plurality of transversely extending fins.

Preferably each said frame member is a plate.

Preferably said interconnecting means includes at least one rod configured to secure said frame members to each other.

Preferably said interconnecting means is configured to prevent said frame members being moved closer together than a predetermined distance.

Preferably said interconnecting means is connected to said frame members by screw-threaded connections.

The device preferably further includes a plurality of insulators, each disposed at least partly within a respective housing and having a respective one of said electrical connectors disposed therein. Each insulator is preferably complementarily received within its respective housing. Preferably each housing includes a continuous inner surface and the respective insulator abuts substantially all of that surface.

Preferably each said insulator protrudes from its respective housing.

In an embodiment of the invention, each insulator is of a material which includes polytetrafluoroethylene (PTFE).

In an embodiment if the invention, each insulator is of PTFE. In one embodiment, the PTFE is of the brand Teflon.

Preferably each electrical connector includes a first part and a second part, these two parts being separably connected to each other, one of said parts being configured for

electrical connection to a respective core of said cable, and the other of said parts being configured for electrical connection to a core of said conductor.

Preferably each first part includes a thimble for receiving a terminating end of a respective core of said cable. In an embodiment of the invention, each said thimble preferably has deformable walls which are crimped onto the respective terminating end thereby to hold said end captive. In an embodiment of the invention, each said thimble is connected to the respective terminating end by soldering.

Preferably each first part is screw-threadedly attached to the corresponding second part.

Preferably each second part is a pin. More preferably, each second part is a pin having a first end and a second end opposite the first end and defining a central passage extending between, and opening through, said first and second ends.

Preferably said first and second parts of each electrical connector are bolted together by a bolt which was inserted through the respective first end and which extends through the respective second end into the corresponding first part.

Preferably one of said parts of each electrical connector defines a tapered cup and the other of said parts of the respective electrical connector defines a tapered formation, the tapers of said cup and tapered formation substantially corresponding to each other, said parts mating with each other by way of said tapered formation being received in said tapered cup.

Preferably each of said parts of each electrical connector defines an interference shoulder and each insulator defines corresponding interference shoulders that engage the interference shoulders on said parts for locating, and holding captive, the respective electrical connector within the insulator when said parts are connected to each other.

Preferably each insulator defines a constricted bore towards the centre of the insulator along its length, for securely accommodating the corresponding electrical connector.

Preferably each insulator has a radially inner tapered shoulder adjacent the respective constricted bore to facilitate insertion of at least part of the electrical connector into the constricted bore.

Preferably each first part has a radially outer wall which engages an abutting wall of the respective insulator and which is configured to prevent rotation of said one part relative to said insulator. More preferably, each said wall defines a substantially hexagonal circumferential path around the respective first part.

The device preferably further includes a plurality of electrical interconnectors each for electrically interconnecting a respective second part with a respective core of said electrical conductor.

In an embodiment of the invention, each said electrical interconnector includes a radially outer insulating shroud and an electrically conductive interconnector formation disposed radially inwardly of the shroud for receiving at least part of the respective second part.

In an embodiment of the invention, the device further includes a plurality of electrical interconnectors each for electrically interconnecting a respective pin with a respective core of said electrical conductor, wherein each said electrical interconnector includes a radially outer insulating shroud and an electrically conductive socket formation disposed radially inwardly of the shroud for receiving therein at least part of the respective pin.

Preferably each insulator together with its respective pin define an annular space at one end of the insulator, said shroud and socket formation being configured for substantially filling the annular space when said pin is received in the socket formation.

In an embodiment of the invention, the device further includes an outer casing.

Preferably the remainder of the device apart from the casing is slidingly received in the casing.

In an embodiment of the invention, there is a filling compound introduced into the casing.

According to a second aspect of the invention there is provided a method for electrically connecting a multi-core cable to a multi-core electrical conductor, the method including:

electrically connecting each core of the cable to a corresponding core of the conductor, by means of a plurality of electrical connectors;

having each said electrical connector accommodated and fully surrounded by a respective one of a plurality of separate rigid protective housings; and

having said housings rigidly connected to one another by means of frame means.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a section through an electrical connecting device according to the invention;

Figure 2 is a view of the device of Figure 1 in the direction of arrow II;

Figure 3 is a detailed section view of a component of the device;

Figure 4 is a view of the component of Figure 3 in the direction of arrow IV;

Figure 5 is a section through an interconnector to be used with the device of Figure 1;

Figure 6 is a section through the device of Figure 1 and a casing in which the device is disposed;

Figure 7 is a section through a blanking cover to be used with the device and casing of Figure 6; and

Figure 8 is a partial view of the blanking cover of Figure 7 in the direction of arrow VIII.

DETAILED DESCRIPTION

Referring to the drawings, there is shown an electrical connecting device 1 for electrically connecting a multi-core cable 2 to a multi-core electrical conductor (not shown). Device 1 includes a number of electrical connectors 3 of silver-plated copper, each for electrically connecting one of the cores 4 of cable 2 to a respective core of the conductor. Three spaced apart and separate, rigid protective cylindrical copper housings 5 of round cross-section each accommodate, and fully surround, a respective electrical connector 3. In another embodiment, the housings are cylindrical, but of non-circular cross-section. It will be appreciated that the housings are rigid when forming part of device 1 as described, although, in one embodiment, the housings are not be rigid when separate from the remainder of device 1. Reference to the housings fully surrounding the connectors 3 is to be understood in the sense that the housings form a continuous path around the connectors, and not necessarily that the housing enclose the connectors. Any corresponding use of the terms "surround" or "surrounding" in the remainder of this specification are to be understood in the same way. Frame means in the form of two spaced apart brass plates 6 and 7 are provided for rigidly connecting housings 5 to one another.

In some embodiments the conductor is another connecting device similar to device 1, while in other embodiments the conductor is an adaptor or a terminating socket.

Each housing 5 is of copper and is therefore electrically conductive. Housings 5 are spaced from one another so as to be parallel to, and longitudinally co-extensive with, one another. As a result of the electrical conductivity of housings 5, they serve as phase barriers between the phases of the respective cores 4 of cable 2, for the length of the housings.

Plates 6 and 7 are disposed at opposite ends of housings 5, and are interconnected by interconnecting means in the form of brass rods 8 and 9. In one embodiment, plate 6 is soft-soldered to each of housings 5 to ensure effective earthing of the housings and hence their effective functioning as phase barriers. In another embodiment, plate 7 is soft-soldered to each of housings 5 for this purpose. Each rod 8 and 9 is attached at one end to plate 6, by means of counter-sunk screws 10 passing through apertures 11 in plate 6. At the opposite ends of rods 8 and 9 are threaded bolt-ends 12 and 13, respectively, which extend through apertures 14 in plate 7 and beyond the plate. Rods 8 and 9 secure the plates 6 and 7 to each other in a manner which will be described below. It will be appreciated that housings 5 are held captive by plates 8 and 9. Each rod 8 and 9 has a pair of shoulders 15 and 16 to prevent plates 6 and 7 moving closer together than the distance between the respective shoulders.

An elongate brass phase barrier 17 extends from plate 7 in a direction away from plate 6. Phase barrier 17 has three fins 18 which extend transversely at equally spaced angles to each other. Phase barrier 17 is secured to plate 7 by means of bolt-end 12 which is engaged with a screw-threaded aperture 19 in the base of the barrier. Phase barrier 17 thus holds plate 7 in firm engagement with shoulder 16 of rod 8. Accordingly,

tightening phase barrier 17 on threaded bolt-end 12 serves to secure plates 6 and 7 together and to hold housings 5 captive between the plates.

One corner 20 of the free end of each fin 18 is radiused to avoid there being a sharp edge which might result in a charge concentration, which in turn might exacerbate the Corona effect.

In each housing 5, there is located an insulator 21, each insulator having a portion 22 protruding from its respective housing. Insulators 21 are of a material known by the brand name Teflon.

It will be noted that each connector 3 is disposed within a respective insulator 21. Insulators 21 are configured such that their outer surfaces 23 are received complementarily in housings 5. Consequently, the corresponding inner surfaces 24 of housings 5, which are substantially continuous surfaces, are abutted by outer surfaces 23 substantially over the entire area of surfaces 24. Each insulator 21 has an annular recess 25 at one end to form a spigot 26. Similarly, each insulator 21 has a further annular recess 27 in a shoulder 28 along the length of the insulator, which also forms, in essence, a spigot 29. Spigots 26 are received in complementary apertures 30 in plate 6 and spigots 29 are received in complementary apertures 31 in plate 7. Spigots 26 and 29, and apertures 30 and 31 serve to locate insulators 21 between plates 6 and 7. A neoprene O-ring 32 is disposed between recesses 25 at the base of spigot 26. The structure and shape of insulators 21 is discussed further below.

Each connector 3 has a first part 33 and a second part 34, these two parts being separable from each other. Each part 34 includes a thimble 35 having a cavity 135 for receiving a terminating end 36 of a core 4 of cable 2. Each thimble 35 has deformable walls 37 which, in use, are crimped onto the relevant end 36 for gripping that end and

establishing an electrical connection to core 4. Alternatively, or in addition, cores 4 are connected to thimble 35 by means of soft soldering.

Each part 33 in the form of a hollow pin 137. Pins 137 each have a central passage 38 extending between, and opening through, opposite ends 39 and 40 of the pin.

Part 34 of each connector 3 defines a tapered cup 41 and part 33 of each connector 3 defines a tapered formation 42. The tapers of cups 41 and formations 42 substantially correspond to each other to permit each pair of parts 33 and 34 to be located with respect to each other by way of the tapered formations 42 being received in the tapered cups 41.

Parts 33 and 34 of each connector 3 are secured to each other by a socket-head stainless steel screw 43. Each screw 43 is inserted through end 39 of the respective pin 137, and extends through end 40 of the pin into the respective part 34. Screws 43 engage with a screw-threaded holes 44 in the respective parts 34.

Each insulator 21 has openings 45 and 46 at its opposite ends and has a constricted bore 47 centrally positioned along its length, for securely accommodating the relevant connector 3.

To assemble each connector 3 and its respective insulator 21, parts 33 and 34 are inserted in openings 45 and 46, respectively, so that the mating ends of the parts extend into the constricted bore 47.

Insulator 21 each have a radially inner tapered shoulder 48 at one end of constricted bore 47, to facilitate insertion of part 34 into the constricted bore. A similar taper is not required at the other end of constricted bores 47 to facilitate insertion of parts 33, as these parts already have tapered formations 42 which are able to serve a similar function.

Parts 34 each have two shoulders 49, and each insulator 21 has corresponding shoulders 50, for abutting with shoulders 49. Similarly, each part 33 has a shoulder 51, and each insulator 21 has a corresponding shoulder 52. An O-ring 53 is interposed between each pair of shoulders 51 and 52 so that these shoulders engage each other indirectly, via the O-ring. When parts 33 and 34 of connector 21 are secured to each other, the engagement of the shoulders 50 and 51 with the shoulders 49 and 52, respectively, holds the connectors captive relative to the insulators.

Each part 34 has a radially outer wall 54 which engages an abutting wall of the respective insulator 21. Part 34 is substantially hexagonal in cross-section at outer wall 54, to prevent rotation of parts 34 relative to insulators 21. Thus, when parts 33 and 34, and insulators 21 are being assembled, and screws 43 are tightened in place, parts 34 are prevented from rotating and this facilitates tightening of the screws. As a result, an operator need not manually secure parts 34 when screws 43 are being tightened.

Device 1 includes a pilot socket 55 for establishing a pilot connection through the device. Pilot socket 55 is disposed in an insulating tube 56 made of a material known in the trade as "Delrin", the tube being held captive between plates 6 and 7. A pilot connecting pin 57 which is integral with pilot socket 55 is threaded at its end 58. A pilot thimble 59 has a female thread 60 which is screwed onto threaded end 58 to hold pilot socket 55 in place in relation to pilot tube 56. Pilot socket 55, connecting pin 57 and thimble 59 are all made of silver-plated brass alloy.

Device 1 is used to connect multi-core cable 2 to another conductor such as a further like device 1. However, in other embodiments the conductor is an adaptor or a terminating socket, as discussed above. To enable connection of device 1 to such a conductor, there are provided electrical interconnectors 61 (see Figure 5), each for connecting a respective pin 137 to a corresponding core of the conductor (not shown).

Each interconnector 61 has an outer insulating shroud 62 and an electrically conductive formation in the form of a connector 63 having a double-socket 64, of silver-plated copper, disposed within the shroud. In one embodiment, the shrouds are of EPDM rubber. Shrouds 62 are broadest at their centres 65 along their lengths, and taper towards their opposite ends 66 and 67. The taper facilitates insertion into openings 45 of insulators 21. Each socket 64 is configured for securely receiving part of a respective pin 137.

Connectors 63 have threaded passages 68 extending between, and opening into, each of sockets 64. The purpose of threaded passages 68 is explained below.

Insulators 21 together with their respective pins 137 define annular spaces 69 at one end of the insulators. Shrouds 62 and sockets 64 of the interconnectors 61 are configured for substantially filling spaces 69 when pins 137 are received in the sockets.

In use, device 1 is inserted in a casing 70 which, in various embodiments, is of cast SG iron, manganese bronze, gun metal, or aluminium. Casing 70 is of a type which has been substantially used in mining applications, but with innards which differ from device 1. As device 1 is designed to be compatible with casings such as casing 70, the device may therefore be used as a retro-fit connector.

Casing 70 has openings 71 and 72 at its two opposite ends. Accordingly, device 1 is inserted into casing 70 by sliding the device through opening 71. An annular ledge 73 on the inner surface of casing 70, serves as a stop to limit the extent to which device 1 enters the casing. Ledge 73 has a threaded aperture 74 with which rods 9 can be aligned, so that bolt-ends 13 can be threadedly engaged with the aperture. Thus, ledge 73 serves to assist in securing plate 7 to rod 9 in a similar manner to that in which phase barrier 17 assists in securing the plate to rod 8. Accordingly, ledge 73 effectively also assists in securing plates 6 and 7 to each other and therefore in holding housings 5 in place.

It will be appreciated that when device 1 is connected to a conductor as mentioned above, the connection is effected by attaching a flange 75 on casing 70 to a corresponding flange on the conductor using stainless steel bolts (not shown) which extend through apertures 175 in the flange and corresponding apertures in the corresponding flange. Flange 75 as well as the corresponding flange of the conductor are provided with O-ring seals 76.

Cable 2 is passed through opening 72 to allow the cores 4 of the cable to be connected to thimbles 35. Casing 70 includes a gland (not shown) for securing cable 2 in place and sealing opening 72. The particular gland used depends on the particular application and the cable. For instance, cables are available having a pliable wire armour, wire armour, lead or aluminium sheathed armour, or of trailing cable type. The gland is flameproof even without compound filling.

Plate 6 has a groove 78 extending around its circumference with a neoprene O-ring 79 located in the groove. O-ring 79 serves to provide a seal between plate 6 and the rim 80 of casing 70 adjacent opening 71.

Casing 70 includes a pair of ports 180. Ports 180 provide for injecting a filling compound into the casing according to an embodiment of the invention, once a device 1 has been installed. Such a filling compound, where used, assists in eliminating air and moisture and hence in reducing the Corona effect. The presence of two ports 180 allows for the injection of the compound through one of the ports and the escape of air pockets in the compound through the other port, while injection of the compound is taking place.

To effect connection of cores 4 to corresponding cores of another conductor using device 1 as mentioned above, interconnectors 61 are inserted into openings 45 and are then inserted in corresponding openings in the conductor so that the corresponding

pins of the cores of the conductor are received in sockets 64. Thus interconnectors 61 span between device 1 and the conductor, connecting them to each other.

When separating device 1 from a conductor to which it is connected, an interconnector 61 might become stuck in an opening 45 or in a corresponding opening in the conductor, due to the taper of shrouds 62 and the close fits involved. As the outer surface of shrouds 62 are smooth to facilitate insertion into openings 45, and are tapered towards ends 66 and 67, gripping of interconnector 61 to remove it is difficult. To facilitate such removal, a threaded tool (not shown) having an end with a screw thread that is complementary to the thread of passage 68 can be screwed into the passage to provide a means of forcibly withdrawing the interconnector.

The complementary configuration of shrouds 62 and spaces 69, which results in the spaces being substantially closed by the shrouds, significantly eliminates air from within insulators 21 and therefore limits the air surrounding connectors 3. This has the effect of substantially limiting the Corona effect described above.

Accordingly, these features of the above embodiments are likely to assist in increasing the life of connectors 3 and this, in turn, should lower the time and costs required for maintenance and replacement of parts.

Furthermore, the structure of connectors 3, in having parts 33 and 34 that are separable from each other, facilitates maintenance, as pins 137 can be accessed and replaced without requiring direct access to parts 34 and thimbles 35.

Device 1 also includes a blanking cover 81 which may be used to blank off opening 71. This serves to provide flame protection and protection against inadvertent contact, and also to limit the Corona effect, when device 1 is connected to a live power supply, but is not connected to a relevant conductor in the manner described above. Cover 81 includes a plate 82 which in various embodiments is of manganese bronze, SG

iron, or aluminium. Cover 81 further includes three insulating shrouds 83. In one embodiment, these shrouds are of EPDM rubber. A further plate 84 which is secured to plate 82 by screws 85, holds the flanges 86 of shrouds 83 captive against plate 82, thereby also holding the shrouds in place. The shrouds are configured to substantially fill spaces 69 in a similar manner to that in which shrouds 62 and sockets 64 of interconnectors 61 close these spaces. Blanking cover 81 includes apertures 87 which align with apertures 175 so that the blanking cover can be secured to casing 70 in a similar manner to that in which a conductor as referred to above is secured to the casing.

Although the invention has been described with reference to specific embodiments it will be appreciated by those skilled in the art that it may be embodied in many other forms.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. An electrical connecting device for electrically connecting a multi-core cable to a multi-core electrical conductor, the device including:

a plurality of electrical connectors each for electrically connecting a respective one of said cores of the cable to one of said cores of the conductor;

a plurality of separate rigid protective housings, each accommodating, and fully surrounding, a respective one of said electrical connectors; and

frame means for rigidly connecting said housings to one another.

2. An electrical connecting device as claimed in claim 1 wherein said housings are spaced from one another.

3. An electrical connecting device as claimed in claim 1 or 2 wherein each said housing is electrically conductive.

4. An electrical connecting device as claimed in any one of claims 1 to 3 wherein each said housing is of material which includes metal.

5. An electrical connecting device as claimed in any one of claims 1 to 4 wherein each said housing is of copper.

6. An electrical connecting device as claimed in any one of claims 1 to 5 wherein each said housing is cylindrical.

7. An electrical connecting device as claimed in any one of claims 1 to 6 wherein each said housing is of round cross-section.

8. An electrical connecting device as claimed in any one of claims 1 to 7 wherein said housings are parallel to one another.

9. An electrical connecting device as claimed in any one of claims 1 to 8 wherein said housings are longitudinally co-extensive with one another.

10. An electrical connecting device as claimed in any one of claims 1 to 9 wherein said frame means includes two spaced-apart frame members disposed at respective ends of said housings, said frame members being interconnected by interconnecting means, whereby said housings are held captive substantially between said frame members.

11. An electrical connecting device as claimed in claim 10 including an elongate metallic phase barrier extending from one of said frame members in a direction away from the other frame member.

12. An electrical connecting device as claimed in claim 11 wherein said phase barrier includes a plurality of transversely extending fins.

13. An electrical connecting device as claimed in any one of claims 10 to 12 wherein each said frame member is a plate.

14. An electrical connecting device as claimed in any one of claims 10 to 13 wherein said interconnecting means includes at least one rod configured to secure said frame members to each other.

15. An electrical connecting device as claimed in any one of claims 10 to 14 wherein said interconnecting means is configured to prevent said frame members being moved closer together than a predetermined distance.

16. An electrical connecting device as claimed in any one of claims 10 to 15 wherein said interconnecting means is connected to said frame members by screw-threaded connections.

17. An electrical connecting device as claimed in any one of claims 1 to 16 wherein the device further includes a plurality of insulators, each disposed at least partly within a respective housing and having a respective one of said electrical connectors disposed therein.

18. An electrical connecting device as claimed in claim 17 wherein each insulator is complementarily received within its respective housing.

19. An electrical connecting device as claimed in claim 18 or 19 wherein each housing includes a continuous inner surface and the respective insulator abuts substantially all of that surface.

20. An electrical connecting device as claimed in any one of claims 17 to 19 wherein each said insulator protrudes from its respective housing.

21. An electrical connecting device as claimed in any one of claims 17 to 20 wherein each insulator is of a material which includes polytetrafluoroethylene (PTFE).

22. An electrical connecting device as claimed in any one of claims 1 to 21 wherein each electrical connector includes a first part and a second part, these two parts being separably connected to each other, one of said parts being configured for electrical connection to a respective core of said cable, and the other of said parts being configured for electrical connection to a core of said conductor.

23. An electrical connecting device as claimed in claim 22 wherein each first part includes a thimble for receiving a terminating end of a respective core of said cable.

24. An electrical connecting device as claimed in claim 23 wherein each said thimble has deformable walls which are crimped onto the respective terminating end thereby to hold said end captive.

25. An electrical connecting device as claimed in claim 23 or 24 wherein each said thimble is connected to the respective terminating end by soldering.

26. An electrical connecting device as claimed in any one of claims 22 to 25 wherein each first part is screw-threadedly attached to the corresponding second part.

27. An electrical connecting device as claimed in any one of claims 22 to 26 wherein each second part is a pin.

28. An electrical connecting device as claimed in claim 27 wherein each second part is a pin having a first end and a second end opposite the first end and defining a central passage extending between, and opening through, said first and second ends.

29. An electrical connecting device as claimed in any one of claims 22 to 28 wherein said first and second parts of each electrical connector are bolted together by a bolt which was inserted through the respective first end and which extends through the respective second end into the corresponding first part.

30. An electrical connecting device as claimed in any one of claims 22 to 29 wherein one of said parts of each electrical connector defines a tapered cup and the other of said parts of the respective electrical connector defines a tapered formation, the tapers of said cup and tapered formation substantially corresponding to each other, said parts mating with each other by way of said tapered formation being received in said tapered cup.

31. An electrical connecting device as claimed in any one of claims 22 to 30 wherein each of said parts of each electrical connector defines an interference shoulder and each insulator defines corresponding interference shoulders that engage the interference shoulders on said parts for locating, and holding captive, the respective electrical connector within the insulator when said parts are connected to each other.

32. An electrical connecting device as claimed in any one of claims 17 to 31 wherein each insulator defines a constricted bore towards the centre of the insulator along its length, for securely accommodating the corresponding electrical connector.

33. An electrical connecting device as claimed in claim 32 wherein each insulator has a radially inner tapered shoulder adjacent the respective constricted bore to facilitate insertion of at least part of the electrical connector into the constricted bore.

34. An electrical connecting device as claimed in any one of claims 22 to 33 wherein each first part has a radially outer wall which engages an abutting wall of the respective

insulator and which is configured to prevent rotation of said one part relative to said insulator.

35. An electrical connecting device as claimed in any one of claims 1 to 34 wherein the device further includes a plurality of electrical interconnectors each for electrically interconnecting a respective second part with a respective core of said electrical conductor.

36. An electrical connecting device as claimed in claim 35 wherein each said electrical interconnector includes a radially outer insulating shroud and an electrically conductive interconnector formation disposed radially inwardly of the shroud for receiving at least part of the respective second part.

37. An electrical connecting device as claimed in any one of claims 1 to 36 wherein the device further includes a plurality of electrical interconnectors each for electrically interconnecting a respective pin with a respective core of said electrical conductor, wherein each said electrical interconnector includes a radially outer insulating shroud and an electrically conductive socket formation disposed radially inwardly of the shroud for receiving therein at least part of the respective pin.

38. An electrical connecting device as claimed in claim 37 wherein each insulator together with its respective pin define an annular space at one end of the insulator, said shroud and socket formation being configured for substantially filling the annular space when said pin is received in the socket formation.

39. An electrical connecting device as claimed in any one of claims 1 to 38 wherein the device further includes an outer casing.

40. An electrical connecting device as claimed in claim 39 wherein the remainder of the device apart from the casing is slidingly received in the casing.

41. An electrical connecting device as claimed in claim 39 or 40 wherein there is a filling compound in the casing.

42. A method for electrically connecting a multi-core cable to a multi-core electrical conductor, the method including:

electrically connecting each core of the cable to a corresponding core of the conductor, by means of a plurality of electrical connectors;

having each said electrical connector accommodated and fully surrounded by a respective one of a plurality of separate rigid protective housings; and

having said housings rigidly connected to one another by means of frame means.

43. An electrical connecting device for electrically connecting a multi-core cable to a multi-core electrical conductor substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings and/or examples.

44. A method for electrically connecting a multi-core cable to a multi-core electrical conductor substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings and/or examples.

DATED this 1st Day of November, 2001

CONSOLIDATED MANUFACTURING INDUSTRIES LTD

Attorney: RUSSELL J. DAVIES
Fellow Institute of Patent Attorneys of Australia
of BALDWIN SHELSTON WATERS

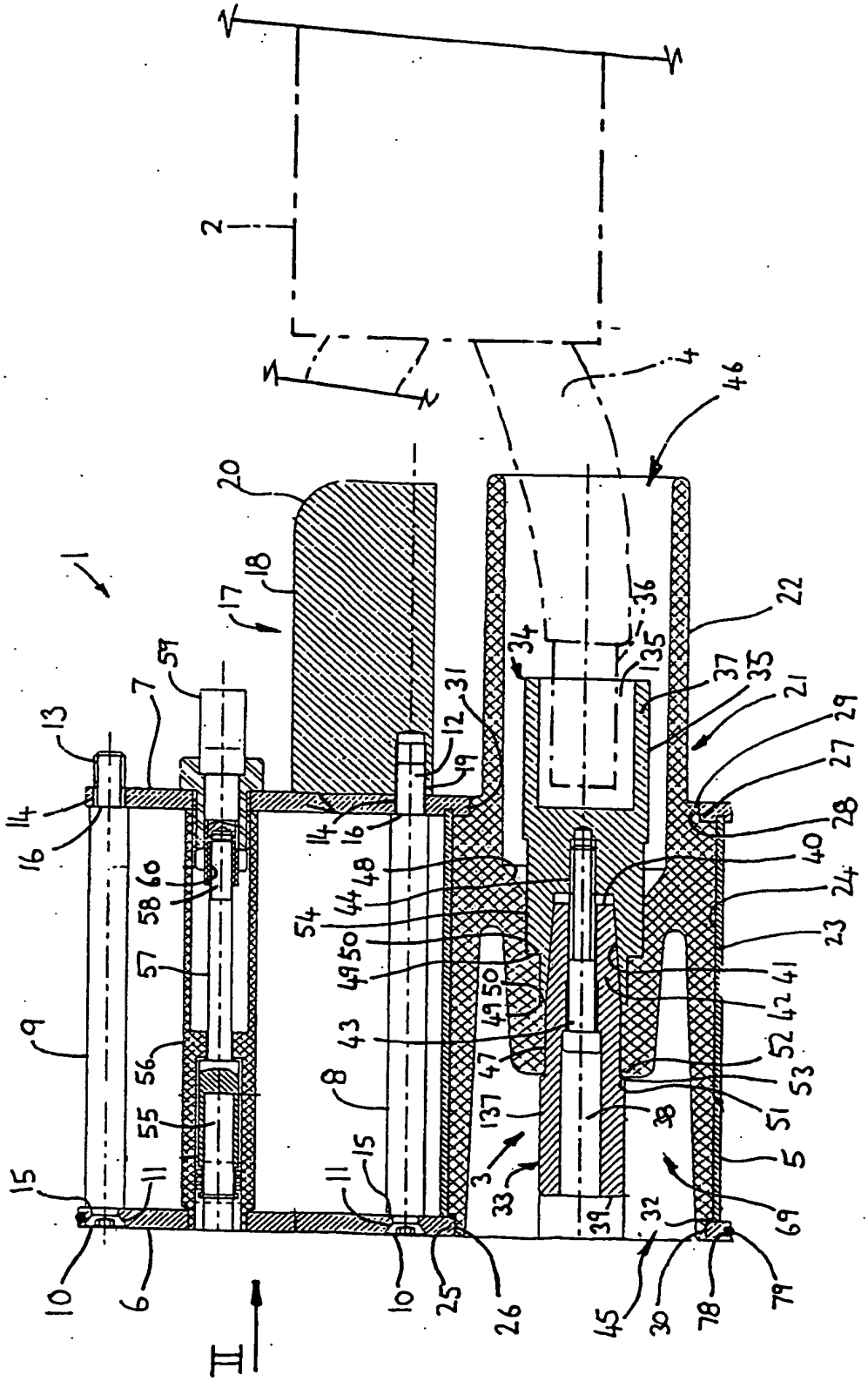
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Fig 1

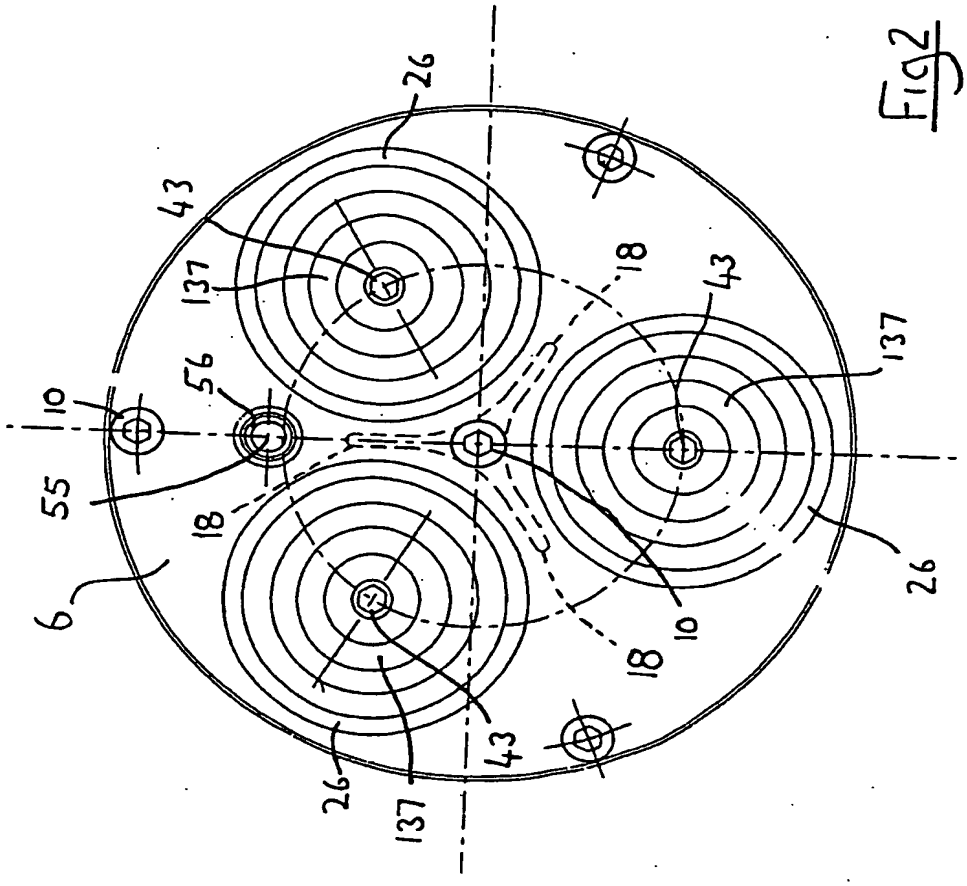


Fig2

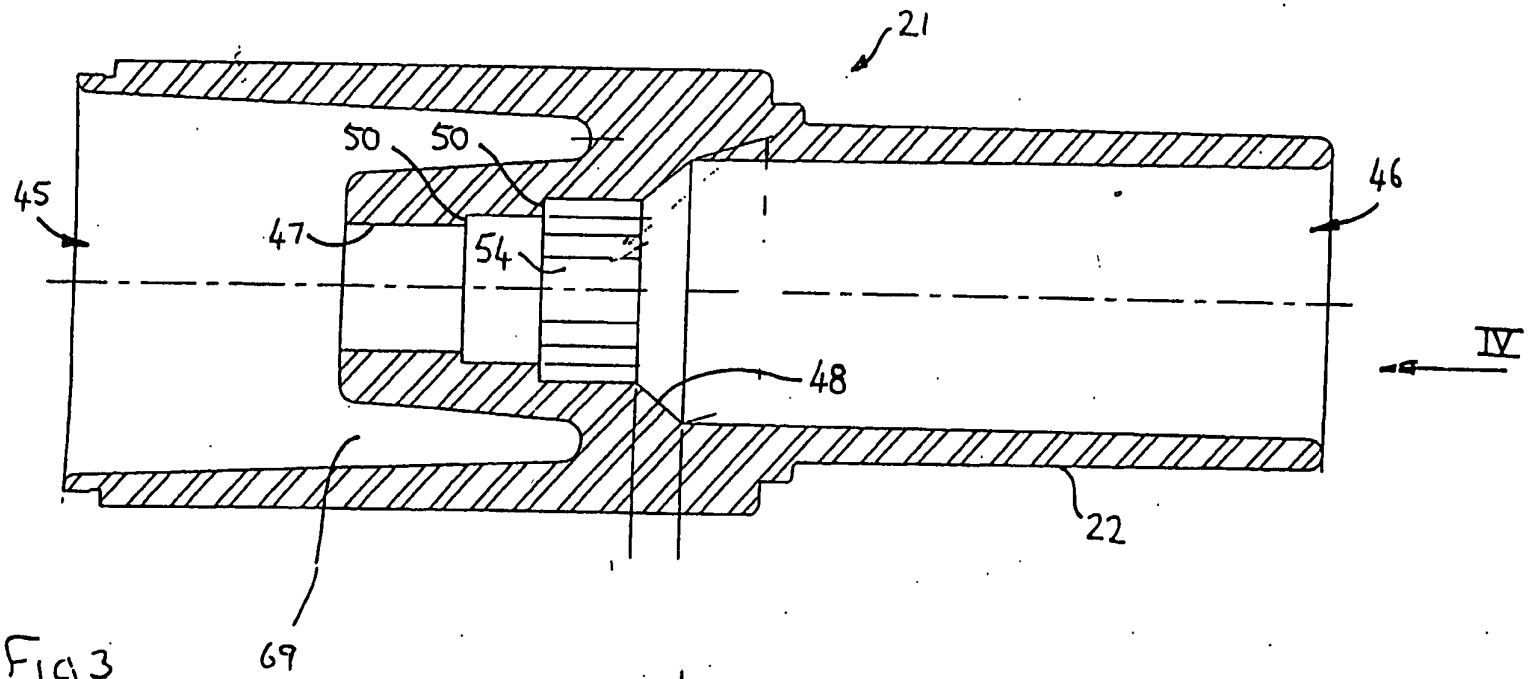


Fig 3

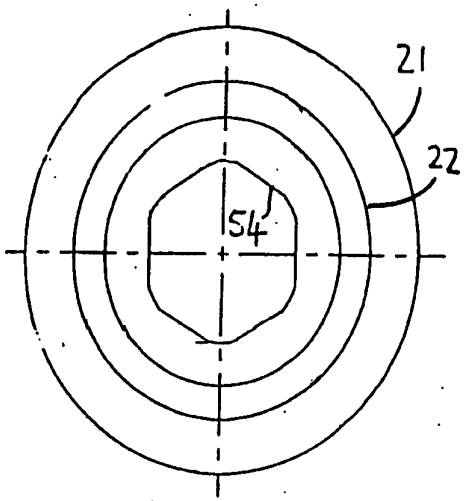


Fig 4

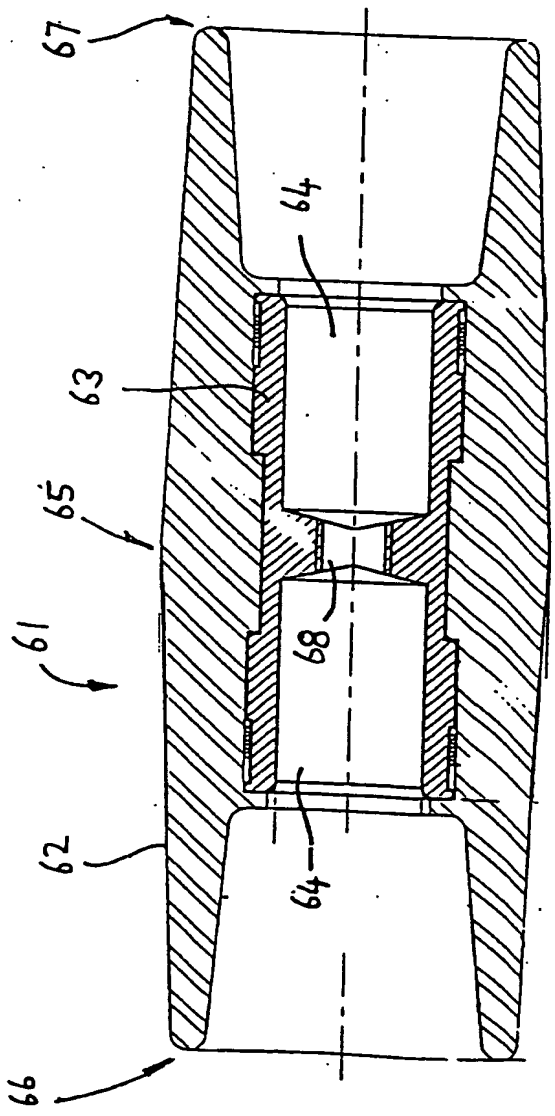
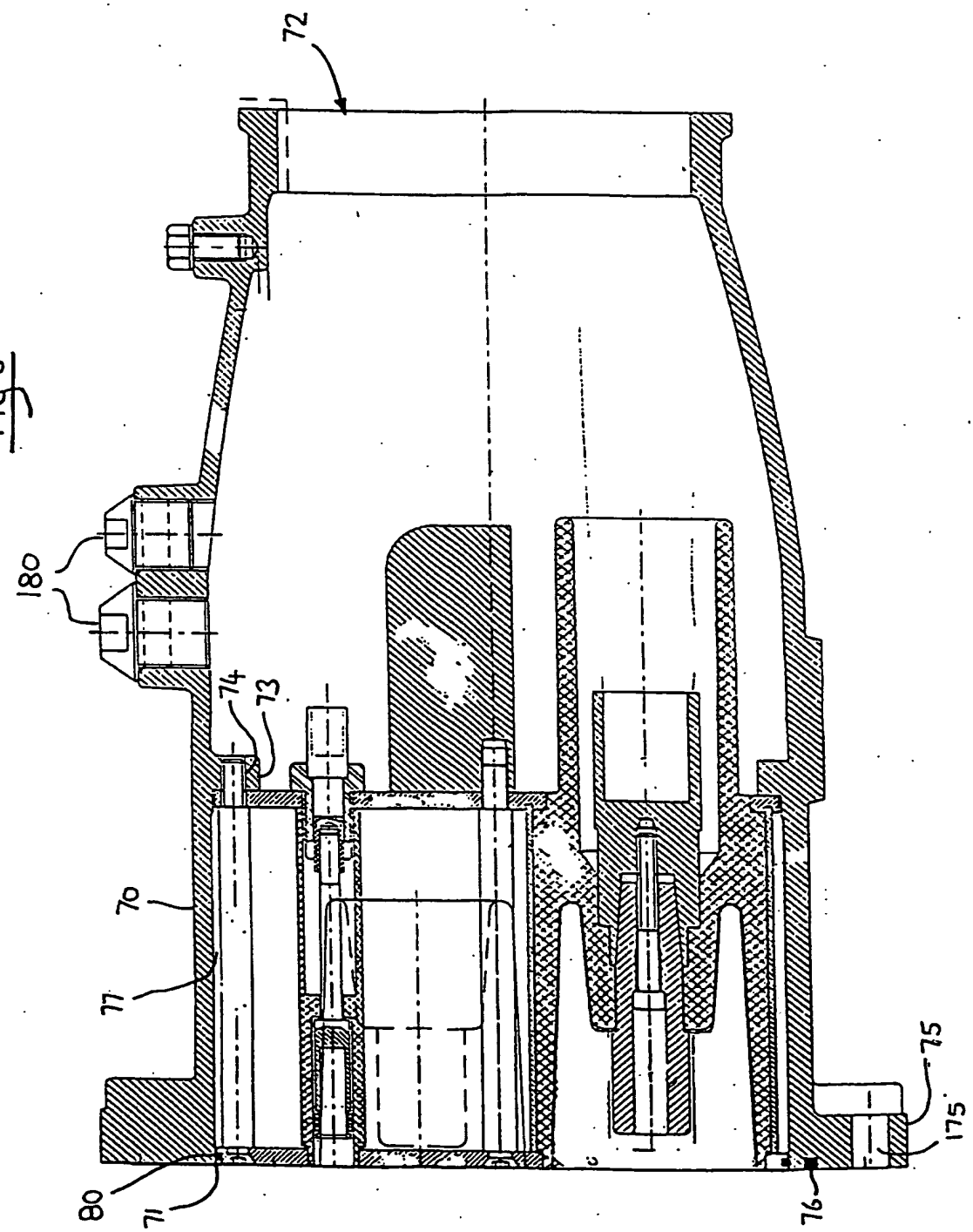


Fig 5

Fig 6



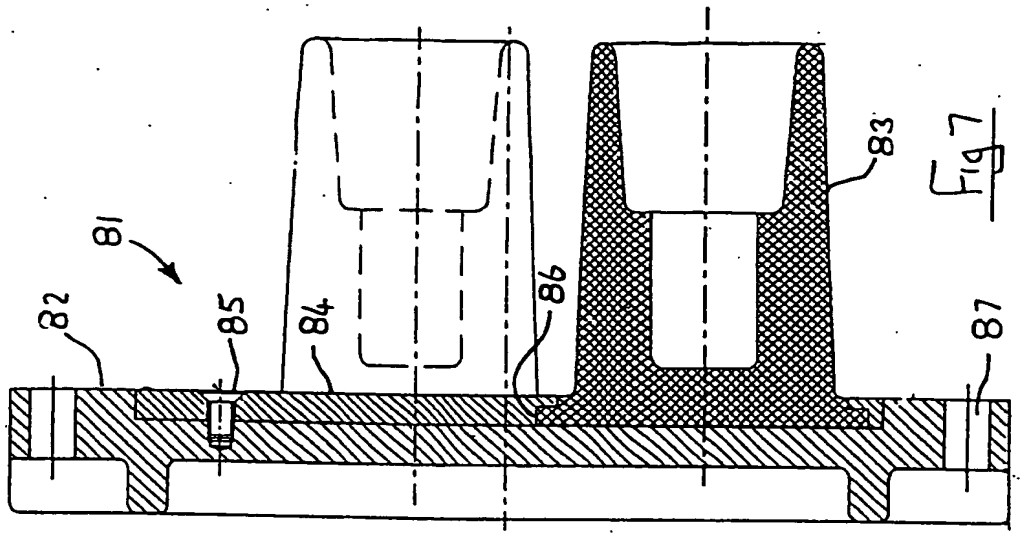

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Fig 7

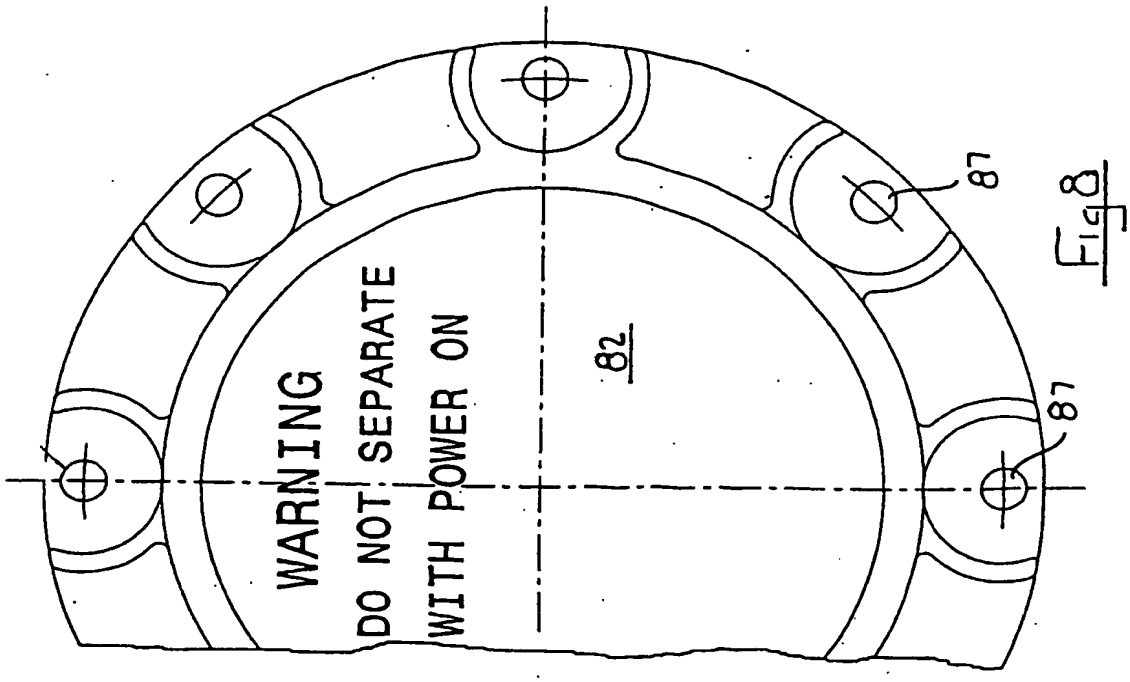
WARNING
DO NOT SEPARATE
WITH POWER ON
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Fig 8